

A TAXONOMIC REVISION OF PODOCARPUS
VII. THE AFRICAN SPECIES OF PODOCARPUS:
SECTION AFROCARPUS

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THE SECTION *Afrocarpus* was set up as a group distinct from section *Stachycarpus* in the first paper of this series (4). The six species included are *Podocarpus falcatus* (Thunb.) R. Br., *P. gracilior* Pilger, *P. Mannii* Hook., *P. usambarensis* Pilger, *P. gracillimus* Stapf and *P. Dawei* Stapf. They are all located in areas of Africa near and south of the Equator.

Extensive work on the geographic distribution of the species and on the taxonomic details has been done by Stapf (16), Chalk et al. (5) and Robyns (13) representing British and Belgian explorations in their respective territories.

Pilger (12) placed this group of species in the subgenus *Stachycarpus*, part B, and authors since have followed this treatment. However, dissatisfaction with this arrangement has been often voiced, particularly by Florin (7) and Orr (11). These species are distinctly different in their leaf anatomy and female cones, being clearly separated in any key, and are, in themselves, "a compact and morphologically homogenous group" (11). They are mostly large trees providing important lumber in areas of abundance.

The leaves in all species are amphistomatic with about the same number of stomata on the upper and lower surfaces. Abundant hypodermal fibers are found at the margin and midrib and gathered in groups between the stomatal rows on both upper and lower sides of the leaf. The palisade parenchyma may be equally distributed on both sides or may be more abundant on the surface exposed to the sun, whether abaxial or adaxial. Often it is poorly developed. The single vascular bundle has one resin canal below it, and is flanked on either side by wings of transfusion tissue which extend far into the blade of the leaf, sometimes more than half-way to the margin. This latter feature has been noted by Orr (11) and Robyns (13) particularly. The only other group in which a similar arrangement has been found is in the section *Polypodiopsis*, *P. minor* and *P. Rospigliossi*. In the parenchyma, around the vascular bundle and transfusion tissue, are numerous, often very large, conspicuous fibers. There is no accessory trans-

* The author of this paper greatly regrets the loss of her associate in this study, Professor John T. Buchholz, deceased July 1951. She wishes to express her appreciation for his assistance in the preparation of this paper, especially the cleared and mounted whole leaves. Also she gratefully acknowledges the permission and assistance which was given to him to examine and photograph specimens of the section *Afrocarpus* preserved in the herbaria of the Royal Botanic Gardens, Kew, the British Museum and Cambridge University.

fusion tissue, but often large pitted sclereids of similar origin develop in the mesophyll between the end of the transfusion tissue and the margin of the leaf (4, PLATE I, FIG. 3).

The abundance, size and position of these sclereids were noted to vary among the samples. A detailed study of these patterns was made in whole mounts of leaves which had been cleared in NaOH and stained with safranin. It has been found that the sclereids are shortest at the base and tip of a leaf, and largest in the middle. They are usually most abundant in the base of the leaf, less so in the remainder, often decreasing toward the tip or even again increasing in number at the very tip. In addition, the number of sclereids increases with the age of the leaf. Thus, the data of TABLE 1 are of doubtful value in distinguishing species because of the abundance of over-lapping sizes in leaves having sclereids under the maxi-

TABLE 1. SCLEREID LENGTH IN SECTION *Afrocarpus*

Species	Min.	Max.
<i>P. gracillimus</i>	50 μ	95 μ
<i>P. falcatus</i>	50 μ	230 μ
<i>P. gracilior</i>	70 μ	265 μ
<i>P. Dawei</i>	60 μ	310 μ
<i>P. usambarensis</i>	65 μ	322 μ
<i>P. Mannii</i>	50 μ	368 μ

mum and the data are not consistent either as to species or geographical region. In a similar examination of the sclereids in the leaves of the *Podocarpus* species, in section *Stachycarpus* (4) from New Caledonia, New Zealand and Australia, patterns of size and abundance sufficiently different to separate the species lines were found. No such clear criteria seem to be apparent in the case of the African group of species.

The following key, adapted from Chalk et al. (5), adding where useful, the characters of leaf anatomy, includes all the species in this group. It is preferable to base a key upon one prepared by individuals familiar with the living trees in the field, where keys are so necessary for identification.

KEY TO SECTION *Afrocarpus*

Leaves small, 1–5 cm. long, 1–4 mm. broad on adult trees; inner woody layer of seed 3 mm. thick or less.

Leaves 2–5 cm. long, 2–4 mm. broad on adult trees (up to 7 or 10 cm. by 6 mm. on young plants and long shoots).

Seed glaucous green, globose, 0.6–1.2 cm. diam. on stalk 0.6–1.2 cm. long; outer layer of seed-shell coriaceous, inner layer very hard, woody, about 1 mm. thick. S. Africa: Cape Province, Natal, Transvaal, s. Mozambique. 1. *P. falcatus*.

Seed brown, more than 1.5 cm. long, inner woody layer more than 1 mm. thick.

Seed ellipsoid-globose, purplish-brown and slightly bluish pruinose, 1.6–1.8 cm. long, 1.4–1.6 cm. diam.; outer layer of seed-shell coriaceous;

inner layer very hard woody, up to 2 mm. thick; branchlets angular from the decurrent leaf-bases. Abyssinia, Kenya, Uganda

. 2. *P. gracilior*.

Seed subglobose, dark or chestnut-brown, 2–2.2 cm. long by 1.6 cm. diam.; outer layer of seed-shell woody, chestnut-brown, inner layer hard-woody, light colored, 3 mm. thick. Uganda 3. *P. Dawei*.

Leaves 1.8–2.5 cm. long, 1–1.5 mm. broad, straight or slightly falcate, acute, densely crowded at the ends of the branchlets; seed up to 2 cm. long, woody inner layer of seed-shell 1–2 mm. thick. Transvaal

. 4. *P. gracillimus*.

Leaves 7.5–15.0 cm. long, 5–10 mm. wide, tapering to a fine point; seed up to 2.5 cm. long, woody inner layer of seed-shell 4–7 mm. thick.

Leaves very shortly stalked, up to 7.5 cm. long, 4–6 mm. wide; seed globose to ellipsoid-globose, about 2.5 cm. long, on a slender stalk 1.2–2.0 cm. long. Tanganyika, Belgian Congo 5. *P. usambarensis*.

Leaves sessile, 7.5–15.0 cm. long, 5–12 mm. wide; seed subpyriform, subsessile, about 3.8 cm. long. West Africa 6. *P. Mannii*.

Podocarpus falcatus (Thunb.) R. Br. ex Mirb. in Mém. Mus. Paris 13: 75. 1825 (nomen); Endlicher, Syn. Conif. 219. 1847; Parlatore in D C. Prodr. 16 (2): 511. 1868; Pilger in Pflanzenreich IV. 5 (Heft 18): 72. 1903, in Nat. Pflanzenfam. ed. 2, 13: 245. 1926; Bernard in Beih. Bot. Centralblatt 17: 275. 1904; Wilson in Jour. Arnold Arb. 9: 143. 1928; Florin in Svenska Vet.-Akad. Handl. ser. 3, 10: 262. 1931; Chalk et al., For. trees and timbers of Brit. Emp. 1: 23. 1932, 3: 86. 1935; Dallimore & Jackson, Handb. Conif. 44. 1923, 1931, 67. 1948; Stapf in Fl. Cap. 5 (Sect. 2, suppl.): 10. 1933.

Podocarpus Meyeriana Endlicher, Syn. Conif. 218. 1847; Parlatore in DC Prodr. 16 (2): 512. 1868.

Podocarpus elongata Carrière, Traité Conif. ed. 2: 671. 1867, in part; Sim, Forests & For. Fl. 335. 1907; Marloth, Fl. S. Afr. 1: 101. 1931–32.

Taxus falcata Thunb., Prodr. Pl. Cap. 117. 1800, et Fl. Cap. (ed. Shultes) 547. 1823.

This species is a tree, often very large, with minute terminal buds, leaves erect, 2–5 cm. \times 3–5 mm., apex shortly acute to almost obtuse (juvenile somewhat larger); male flowers short, solitary or 2–3 together; seed 6–12 mm. diam., globose, with peduncle 6–12 mm. A complete description, including figures, may be found in Chalk et al. (6).

Podocarpus falcatus, from the Cape of Good Hope vicinity, was first described as *Taxus falcata* from a specimen collected by Thunberg in 1773–74, at the same time as *P. elongatus* later to be used as the type for the genus. Both these specimens are in the Botanical Museum at Uppsala. We have seen photographs and examined leaf samples and can designate them as authentic. Toward the latter part of the nineteenth century these two species, with leaves of similar size and shape, became rather hopelessly confused both in the literature and among foresters, and they are still occasionally interchanged in published work. As late as 1943, Smith (15) found it necessary to include these in publishing a verification of the

nomenclature of certain African species of *Podocarpus*. In 1867, Carrière published a description under the name of *P. elongata* Carr. which was only partly *P. falcatus*. Parlatores, in 1868, described *P. falcatus* under that name but the description of the female flowers was of another species. In 1874, Bertrand (2) published his detailed anatomy of conifer leaves in which he described *P. falcatus* under the name of *P. elongata* L'Herit. and placed the former name in synonymy. Mahlert, in 1885, using much of Bertrand's work on conifers, described *P. falcatus* in detail under the name of *P. elongatus* L'Herit. Stiles (17) reconsidered this same data and followed the same misconception. In 1891, Van Tieghem (18), in a paper setting up *Stachycarpus* as a genus, did not include any African species, but he placed *P. falcatus* in *Eupodocarpus* and listed *P. elongatus* as a species having palisade parenchyma on both sides of the leaf.

Pilger (12), in 1903, showed in his taxonomic key and description a clear concept of *P. falcatus* R. Br. as different from *P. elongatus* L'Herit. However, in his preliminary discussion of leaf anatomy preceding the taxonomic part, he repeated the errors of Mahlert and others in describing for *P. elongatus* the leaf anatomy of *P. falcatus*. Later authors continued the confusion. Sim (14) and Marloth (10) redescribed this species in its correct position to affirm its place to African investigators, as did Stapf (16) and Chalk et al. (6) in their listings of strictly South African trees. Orr (11), in making a study of the leaf anatomy of the genus, mentioned the confusion in the literature and found that Bernard labelled a text figure of *P. elongatus* as *P. falcatus* which is the reverse of the usual error.

Orr (11) indicated that this species can be differentiated by the leaf anatomy: "hypodermal fibers are much larger than those of any other species and the groups into which they are segregated project more deeply into the underlying mesophyll." We are not able to confirm this observation as statistical treatment of measurements shows no consistent variation from those of the other species. In a study of the size and abundance of sclereids it was found that those of *P. falcatus* were larger than those of *P. gracillimus* and mostly smaller than those of *P. gracilior*, but in this latter case, the largest sclereids of *P. falcatus* overlapped the smaller in *P. gracilior*, making this data of doubtful use in differentiating these species.

Two varieties have been described by Pilger on the basis of leaf size. *Podocarpus falcatus* var. *latifolius* has leaves 2.5–3 cm. long, 5–6 mm. wide, with the apex short-rotundate. It is represented by a single specimen from Kaimansgat, *Drege 6182*. We have examined a specimen, *Drege 6184*, which does not seem to differ from the species. *Podocarpus falcatus* var. *pondoensis* is one with small leaves, up to 2 cm. long and 3 mm. broad, represented by the single specimen *Bachmann 69*. We have seen no specimen comparable to this and it may be referred to *P. gracillimus* which will be discussed later. These varieties have been ignored by Stapf (16) and Chalk (6) in studies of these African trees.

DISTRIBUTION: Southern part of the African continent in the following districts: Cape Province, Natal, Portuguese East Africa, Transvaal and British Bechuanaland.

SPECIMENS EXAMINED:

SOUTH AFRICA: Transvaal: *Burtt-Davy* 20248 (A*). Natal: Northern Zululand, *Boocock* in 1923 (A—3 sheets); The Doyle, *Wilson* in Jan. 1922 (A), *Wilson* in Feb. 1922 (A—2 sheets). Transkeian Territory: Mananza Forest, Mt. Ayliff, *Cochrane* in 1920 (K). Griqualand East: Buswayo Forest, Manina, *Merwe* Pret. For. Dept. Herb. 2268 (K), *Merwe* Pret. For. Dept. Herb. 2269 (K); Instubani Forest, *Fraser* Pret. For. Dept. Herb. 62A (K), *Fraser* Pret. For. Dept. Herb. 2226 (K); Emkazení For. Res., *Household* Pret. For. Dept. Herb. 1956; Waterfall Farm, *Wilmot* Pret. For. Dept. Herb. 2205 (K). Cape Province: East London, *Kuntze* in 1894 (K, NY); Queenstown Dist., Junction Darm., *Galapin* 8179 (K); King Williamstown Div., Kaffraria, *Cooper* 1297 (†K); Alexandria Forest, *Strauch* 4137 (A); Somerset East, Boschberg, *Burchell* 3174 (K), *Burchell* 3189 (K), *MacOwan* 1561 (†F, K, Ph); Albany Dist., *Prior* in 1848 (K), *Dyer* 3325 (K); Alicedale, *Pulgram* Pret. For. Dept. Herb. 2609 (K); Uitenhage, Elon River, *Drege* 6184 (†Mo), *Drege* 1839 (K), Kamaehs, Long 1280 (K), eastern valley Blaubeerg, *Smuts* 852 (K), Swartkop River, *Prior* in 1847 (K), *Eklon & Zeyher* s.n. (A, †F, †Mo, UC); Humansdorp, Hankey, *Fourcade* 3319 (K), Klein River, Long 1350 (K); Ribeckscastle, Vleermuysdrift, *Thunberg* s.n. (†UPS); Outeniqua Mts., Montagu Pass, *Rehmann* 213 (†BM); Knysna, Kaymansgate, *Drege* in 1839 (K), Plattenberg For., *Bowie* s.n. (K), *Wilson* in 1922 (†A—5 sheets, UC), Vandu Wats, *Burchell* 5293 (K), *Setchell* in 1927 (UC), *Mund & Maire* s.n. (K), in 1840(?) (K); George Division, Gat River, *Drege* s.n. (K), *Burchell* 5761, 6068, 8909 (K). IN CAPE COLONY BUT WITH NO LOCALITY: *Drege* s.n. (†Mo, NY), *Prager* 785 (†CAS), *Anon.* s.n. ex *Scheidweiler* Herb. (†BR), *Burchell* 5245 (GH), *Burchell* 4652 (GH), *Basil* in 1865 (NY), *Anon.* leg. M. & M. (ex HB. Rg. Br.) (GH, NY), *Anon.* s.n. (GH), *Stewart* s.n. (K). No LOCALITY: *Anon.* ex Herb. A.N.S. (†Ph), *Anon.* 10.9 (†Mo), *Anon.* ex Herb. Jan Gen 840½ ex *Bernhardi* Herb. (†Mo—4 elements on sheet), *A. Brown* in 1862 (†Mo), *Anon.* s.n. (BR), *Molliana* in 1833 (†BR), *H.S.* in 1834 (†BR), *Anon.* ex *Gord.* Herb. (K).

CULTIVATED: Cape of Good Hope, "Hort. Daudin" 1851 (†DS in part); Natal, Kirstenbosch, *Bolus* in 1941 (†Ill); France, Riviera, *Schneider* in 1903 (A), "Hort. Monac." (BR in part); Italy, Rome, for *Engelmann* in 1870 (†Mo), Naples for *Engelmann* in 1869 (†Mo); Brazil, Rio de Janeiro, *Whitford* 27 (†F, GH, †US); Australia, *Bowman* in 1921 (A); China, Hongkong, *Chun* 5235 (†UC), *Sargent* in 1903 (†A).

Podocarpus gracilior Pilger in *Pflanzenreich* IV. 5 (Heft 18): 71. 1903, in *Nat. Pflanzenfam.* ed. 2, 13: 245. 1926; *Battiscombe*, *Descr.*

* The following symbols indicate the herbaria having the specimens cited: Academy of Natural Sciences of Philadelphia (Ph), Arnold Arboretum (A), British Museum (BM), Brussels Botanical Garden (BR), University of California at Berkeley (UC), California Academy of Science (CAS), Chicago Natural History Museum (Field Museum) (F), Gray Herbarium (GH), University of Illinois Herbarium (Ill), Kew Herbarium (K), Missouri Botanical Garden (Mo), New York Botanical Garden (NY), Rutgers University Herbarium (NJU), Stanford University Dudley Herbarium (DS), United States National Herbarium (US), Uppsala Botanical Museum (UPS), Yale University Herbarium (YU).

† This symbol preceding the abbreviated name of an herbarium following the specimens examined signifies that the details of the leaves of this specimen have been examined in cross-section.

Cat. of common trees & woody plants of Kenya Colony 1. 1926; Florin in Svenska Vet.-Akad. Handl. ser. 3, 10 (1): 262. 1931; Chalk, Burt-Davy & Desch, Forest trees and timbers of Brit. Emp. 1: 23. 1932; Giordano in L'Alpe 24: 417. 1937; Buchholz in Madroño 6: 119. 1941; Stapf in Fl. Cap. 5 (Sect. 2, suppl.): 13. 1933.

This species differs from *P. falcatus* chiefly in its more restricted range in the forests of tropical Africa. Pilger differentiated it primarily by the larger male cones, 1.5–3 cm. long, its scales with acute apices (instead of obtuse), the more patent, fairly loosely arranged leaves, and the larger seeds, 12–20 mm. long. Stapf (16) finds the leaves mostly long tapering to a sharp point and narrower. He notes the similarity to *P. falcatus* and suggests that it may be only a geographical variety.

Podocarpus gracilior is cultivated as an evergreen exotic in California and has been distributed widely in tropical-plant houses. The tree has been called *P. elongatus*, an error which was corrected by Buchholz in 1941 (3). At the same time several additional differences from *P. falcatus* were noted. *Podocarpus gracilior* has green twigs, the leaves are longer and wider, and the pollen cones are twice as long.

In the description which Battiscombe (1) included with his listing of this species from Mt. Elgon in Kenya Colony, the small seed must be an error and $\frac{1}{2}$ in. long was meant.

DISTRIBUTION: Eastern Africa, on mountain slopes in tropical regions.

SPECIMENS EXAMINED:

ETHIOPIA: Addis Ababa, *Armbruster* in 1915 (K); Mt. Chillalo, *Scott s.n.* (K); Galla Pass, *Gillett 5132* (K); West Sidamo, *Drake-Brockman 205, Brockman 244* (K); Djem-Djem Forest, *Cooper s.n.* (K); Kena Valley, Alafa, *Cheesman 7445* (K); Chere, *Quartin-Dillon & Petit 105* (K); *Schimper 1160* (TYPE) (K); *Schimper 1539* (+BR); *Mearns 92* (+BR); *Roth s.n.* in 1841 (K); *Stordy s.n.* (K). KENYA: between the Oljoro-o-Nyon and Narok Rivers, *Mearns 373* (+US), *Mearns 382* (CU, +F, GH, NY—2 sheets), *Mearns 1382* (GH, NY); NW Kenya, *Hutchins 400, 598* (K); Laikipia Plains, 20 m. from Kenya, *Hutchins 399* (K); Coles Farm, *Fries 801* (+BR, K); Myeri Dist., *Decie* in 1926 (+BM); Walenso, *A. Donaldson Smith 217* (+BM); Mau escarpment, *Wilson* in Dec. 1921 (A—5 sheets); beyond Londoni, *Wilson* in Dec. 1921 (A—4 sheets); SW Kenya, *Hutchins s.n.* in 1906 (K); Nairobi Dist., *Gardner 1110* (K), *Wilson* in Nov. 1921 (A—4 sheets, 1 seedling), *Wilson* in Jan. 1922 (A—2 sheets); *Fuller 683* (A); *Mettam* in 1928 (DS); *Curtis 901, 1071* (A). UGANDA: Kaburon, Mt. Elgon, *Eggeling 2474* (K), *Eggeling 2479* (+BR); Mt. Elgon, *Lugard 64, 64a* (K), *Jackson 352a* (K); Nandi & Ravine Dists., *Johnston* in 1900 (K); Eldoma Ravine, *Johnston* in 1899 (K), in 1900 (K), *Whyte* in 1898 (K); Mt. Debasien, Karamoja, *Thomas 2953* (K); Masai County, Ty Kipia, *Thomson* in 1884 (K); Ruwenzori Exped., *Scott-Elliott 6959* (K). TANGANYIKA TERRITORY: Mt. Kilimanjaro, Gereragua, *Zimmermann 1783* (K); Mt. Meru, *Greenway 4434* (K); Kondoa Dist., Salanga Hill on Bereku Ridge, *Burt 1069A* (K—2 sheets), *Burt 1070* (K—2 sheets), Kinyassi Mtn. *Burt 910* (K); Mt. Hanang, Nangwa, *Greenway 7602* (K); Bukoba, Minsiro Forest, *Wigg 303* (K). LOCALITY UNKNOWN: *Burt 1174* (+K

in part); ex Scheidweiler Herb. (BR); *Anon. s.n.* (†BR); *Parker s.n.* (A); *Anon. s.n.* (†Mo).

CULTIVATED: Kenya: Nairobi Arboretum, *Eggeling 3570* (K), Kirstenbosch, *Graham* in 1941 (†Ill). Tanganyika; Cons. Forests in 1932 (A, †BR, K, †Mo, NY). Cameroons: *Maclant 344* (K). Cape of Good Hope: ex Herb. John Miers (†BM), Forest Nursery, *Wilson* in 1921 (A-seedlings). India: Dehra Dun, *Raizada 5028* (K). Switzerland: *Schneider* in 1903 (A). England: Kew, Temp. House, *Cook* in 1937 (†Ill). U.S.: California, Rosecroft Gardens, *Buchholz* in 1941 (†Ill—2 sheets); Santa Barbara Bot. Gard. *Moran 2529* (Dearing Herb., †Ill); San Diego, *Wangenheim* in 1941 (Ill); Pasadena, Coolidge Nursery, *Buchholz* in Jan. 1941 (A, Ill), in Feb. 1941 (A, Ill); Berkeley Bot. Gard. *Nelson* in 1941 (Ill—2 sheets); Santa Barbara, *Van Rensselaer 1727* (Ill—2 sheets), *1801* (Ph).

Podocarpus Dawei Stapf in Fl. Trop. Afr. ed. Prain, 6(2): 342. 1917; Florin in Svenska Vet.-Akad. Handl. Ser. 3, 10: 262. 1931; Chalk, Burtt-Davy & Desch, For. trees & timbers of Brit. Emp. 1: 23. 1932.

A typical member of section *Afrocarpus*, it differs from *P. falcatus*, *P. gracilior* and *P. gracillimus* by the subglobose, chestnut-brown seed with inner woody layer 3 mm. thick. Chalk (5) also differentiates it from *P. usambarensis*, found in the same area, by the smaller leaves, but this becomes a very doubtful criterion after noting the ecological variations in the latter species seen in the specimens and described in detail by Robyns (13).

DISTRIBUTION: Tropical Africa, Uganda.

SPECIMENS EXAMINED:

Uganda: south Budda, near Kagera River, *Dawe 961* (†K, TYPE); Podo. Mt. Debasien at Mareyo, *Eggeling 2704* (†BR); Masaka, Katua, *Eggeling 5566* (K—3 sheets and seeds in alcohol); Kigezi Dist., Kayonso forest, *Fyffe* in 1928 (K—2 sheets), *Eggeling 4180* (K-seedling). Belgian Congo: near Matemba, between Lubango & Luofu, w. of Lake Edward, *Chapin 264* (†NY).

CULTIVATED: Uganda: Entebbe, *Eggeling 5712* (with seeds in alcohol) (K), *Eggeling 5711* (K). Natal: near Durban, *Wood 3005* (†K).

Podocarpus gracillimus Stapf in Fl. Trop. Afr., ed. Prain, 6 (2): 343. 1917; Chalk, Burtt-Davy & Desch, For. trees and timbers of Brit. Emp. 1: 23. 1932; Stapf in Fl. Cap. 5 (Sect. 2, suppl.): 14. 1933.

This species is represented primarily by a single specimen, *Nelson 423* from Transvaal, with small leaves (1.8–2.5 cm. long by 1–1.5 mm. broad) and a seed 20 mm. in length. The leaf anatomy was inadvertently described by Laurent (8) in connection with his description of *P. rostratus*. We have examined a photograph of this specimen and a leaf from it, which shows, as he described, palisade parenchyma on both sides, sclerified fibers in the parenchyma and hypoderm in discontinuous groups, and indicates that it is amphistomatic. He also described three resin canals under the vascular bundle, but we are unable to verify this observation as we find only one in that position. If three resin canals do occur, it is the only member of *Afrocarpus* having them. Orr (11) says that it has the

largest vascular fibers, but these vary so much in size among all the species and even in a single section from a leaf that it is a doubtful diagnostic feature.

In the statistical study of the abundance and form of the sclereids of the accessory transfusion tissue, it was found that these were by far the smallest and shortest, not exceeding 95μ in length.

In Stapf's (16) later estimate of the status of *P. gracillimus*, it is a "very doubtful and incompletely known species. It may represent merely a state of *P. gracilior*, in which the reduction of the leaves and breadth characteristic of the fruiting stage has been carried to excess." Sim (14) had previously suggested this explanation. A similar state was collected by A. Whyte in the Eldama Ravine, Kenya, "along with typical *P. gracilior*." Stapf adds *Burtt-Davy 5083* as a possible example and we can include several specimens from American herbaria which are listed below.

DISTRIBUTION: South Africa, in Transvaal and Natal.

SPECIMENS EXAMINED:

TRANSVAAL: Houtschberg, *Nelson 423* (+K); NATAL: Zululand, *Bal-landen 2925* (A—2 sheets); *Wilson* in 1922 (A).

CULTIVATED: Transvaal, in Helpmakaar Arboretum, *Burtt-Davy 20227* (+A).

Podocarpus usambarensis Pilger in *Pflanzenreich* VI. 5 (Heft 18): 70. 1903, in *Nat. Pflanzenfam.* ed. 2, 13: 245. 1926; Stapf in *Fl. Trop. Afr.* ed Prain, 6(2): 341. 1917; Dallimore & Jackson, *Handb. Conif.* 57. 1931, 84. 1948; Florin in *Svenska Vet.-Akad. ser. 3*, 10: 262. 1931; Chalk, *Burtt-Davy & Desch, For. trees & timbers of Brit. Emp.* 1: 23. 1932; Robyns in *Inst. Roy. Colon. Belge, Bull.* 6(1): 236. 1935, in *Flore du Congo Belge et du Ruanda-Urundi* 1: 5–6. 1948.

Podocarpus falcatus Engl. in *Pflanzenwelt Ostaf.* C: 92. 1895.

This species is distinguished by Pilger (12) and Chalk (5) from *P. falcatus* and *P. gracilior* by the thicker inner woody layer of the seed and from *P. Mannii* by the shorter leaves and smaller, more globose seed. However, it closely resembles the two former species and Robyns (13) has given a very pertinent discussion (translated) of the status of this species: "It is true that *P. usambarensis* has an area of distribution more tropical than *P. gracilior*, that it is only described from Abyssinia, Uganda, or Kenya, but it is possible that these groups represent in reality two geographic varieties of one and the same species. We note, moreover, that Stapf has shown that the diagnostic characters of *P. gracilior* and *P. falcatus* are confused and that it is reasonable, also, to consider *P. gracilior* as a geographical variety or the tropical form of *P. falcatus*. A comparative study of the three species in question will lead then, very probably, to their fusion into a single species, which should be called *P. falcatus*, according to the laws of nomenclature."

We would concur with Robyns in this matter and perhaps add *P. gracillimus* and *P. Dawei* to the series. However, we believe that *P.*

usambarensis can be distinguished by the large seeds even though this may not be a character of specific rank. Also the leaves usually seem to be stiffer and more abruptly pointed, not as falcate as *P. gracilior*.

We have tried to confirm Orr's (11) statements that the accessory trans-fusion sclereids are "more numerous and conspicuous here," and that the hypoderm "has the appearance of being interrupted at greater intervals" and is in an "unbroken layer above and below vascular bundle." We do not find these to be any more true in this than in the other species.

DISTRIBUTION: Tropical Africa, in Belgian Congo and Tanganyika.

SPECIMENS EXAMINED:

BELGIAN CONGO: Lac Mokoto, *Claessens 52* (†BR). RUANDA-URUNDI: Rubongera, *Lestrade 2* (†BR). TANGANYIKA: Kilimanjaro, north side, *Schlieben 5129* (†ex Berlin Herb. Florin, †BR, Ill, †YU); Mt. Usambara, *Holst 2467* (†K); Kondoia Dist., *Burt 1069* (K—2 sheets), *Burt 1174* (K).

CULTIVATED: Tanganyika: Runjwa Dist., *Davies*, Dept. Agr. D211 (†K); Jamaica: Cinchona, *Nichols 167* (†F, GH, †Mo, NY, US, YU); *Schwaby* in 1943 (Ill); *Buchholz* in 1946 (†Ill); *Chrysler 1460* (NJU); *Scheidweiler s.n.* (†BR).

Podocarpus Mannii Hook f. in Jour. Linn. Soc. 7: 218. 1864; Pilger in Pflanzenreich IV. 5 (Heft 18): 70. 1903, in Nat. Pflanzenfam. ed. 2. 13: 245. 1926; Henriques in Biol. Soc. Brot. 5: 216. 1887; A. Nobre in Boletim da Soc. Brot. 7: 115. 1889, in Pflanzenwelt Ostaf. C: 92. 1895 (not Engl.); Stapf in Fl. Trop. Afr., ed. Prain, 6 (2): 341. 1917; Seybold in Bot. Abh. 6: 49. 1925; Florin in Svenska Vet.-Akad. Handl. ser. 3, 10: 262. 1931; Dallimore & Jackson, Handb. Conif. 50. 1931, 74. 1948; Chalk, Burt-Davy & Desch, For. trees & timbers of Brit. Emp. 1: 23. 1932; Chevalier in Rev. Bot. Appl. 19: 411. 1939.

This species has the largest leaves and seeds of any species in the group. The leaves are 12–16 cm. long by 7–11 mm. wide (shorter on flowering shoots), and the seed, narrowed at the base, solitary, is found up to 3.8 cm. long on a peduncle 2–3 cm. long. The auxiliary sclereids also reach the greatest length, 368 μ .

Podocarpus Mannii is a rare species found native only on St. Thomas Island, cultivated in the forests of Cameroons and in California in Griffith Park. Herbarium specimens were collected in 1944 from 2 yr. old seedlings raised in this latter place from seeds obtained from Buenos Aires, presumably from cultivated trees.

DISTRIBUTION: Western tropical Africa, north of the Equator.

SPECIMENS EXAMINED:

WEST AFRICA: St. Thomas Island: *Mann 1065* (TYPE) (†GH—2 sheets, †K—2 sheets), *Spangler* in 1897 (†BR), *Exell 339* (†BR).

CULTIVATED: Cameroons: Buea, *Dartel 557* (A), *Maitland 343* (K), *Fairchild SPD74656* (K), *Anon. 345* (K); California: Griffith Park, *Buchholz* in 1944 (†Ill—2 sheets).

LITERATURE CITED

1. BATTISCOMBE, E. A descriptive catalogue of some of the common trees and woody plants of Kenya Colony. London. 1926.
2. BERTRAND, C. E. Anatomie comparée des tiges des feuilles chez les Gnétacées et les Conifères. Ann. Sci. Nat. Paris, ser. V. 20: 5-153. 1874.
3. BUCHHOLZ, J. T. *Podocarpus gracilior* in cultivation. Madroño 6: 119-122. 1941.
4. BUCHHOLZ, JOHN T. AND NETTA E. GRAY. A taxonomic revision of *Podocarpus*. I. The sections of the genus and their subdivisions with special reference to leaf anatomy. Jour. Arnold Arb. 29: 49-63. 1948; V. The South Pacific species of *Podocarpus*: section *Stachycarpus*. ibid. 32: 82-92. 1951.
5. CHALK, L., J. BURTT-DAVY & H. E. DESCH. Forest trees and timbers of the British Empire I. Some East African Coniferae & Leguminosae. Clarendon Press, N.Y. 66 pp. 1932.
6. CHALK, L., M. M. CHATTAWAY, J. BURTT-DAVY, F. S. LAUGHTON & M. H. SCOTT. III. Fifteen South African high forest timber trees. Forests & timbers of Brit. Emp. Clarendon Press, N.Y. 1935.
7. FLORIN, R. Untersuchungen zur Stammesgeschichte der Coniferales u. Cordaitales. Erster teil. Morphologie und Epidermizstrukture der Assimilationsorgane bei den rezenten Koniferen. Svenska Vet.-Akad. Handl. ser. 3, 10: 1931.
8. LAURENT, M. L. Les *Podocarpus* de Madagascar. Ann. Fac. Sci. Marseille 23: 52-64. 1915.
9. MAHLERT, ADOLPH. Beiträge zur Kenntnis der Anatomie des Laubblätter der Coniferen mit besonderer Berücksichtigung des Staltöffnungs-Apparates. Bot. Centralbl. 24: 278-282. 1885.
10. MARLOTH, R. The Flora of South Africa, with synoptic tables of the genera of the higher plants. Vols. 1-4. Cape Town & London. 1913-1932.
11. ORR, M. Y. The leaf anatomy of *Podocarpus*. Trans. Proc. Bot. Soc. Edinburgh 34: 1-54. 1944.
12. PILGER, R. Taxaceae. Engler Pflanzenreich IV. 5 (Heft 18): 1-124. 1903.
13. ROBYNS, W. Sur les espèces de *Podocarpus* du Congo Belge et du Ruanda-Urundi. Inst. Roy. Col. Belge, Bull. 6: 226-242. 1935.
14. SIM, T. R. The forests and forest flora of the Colony of the Cape of Good Hope. Aberdeen. 1907.
15. SMITH, C. A. Nomenclature of *Podocarpus* species. So. Afr. For. Assoc. Pretoria Jour. 10: 23-28. 1943.
16. STAPF, O. Podocarpaceae. Fl. Cap. 5 (Sect. 2, suppl.): 3-14. Ed. Sir Arthur Hill. 1933.
17. STILES, W. The Podocarpeae. Ann. Bot. 26: 442-514. 1912.
18. VAN TIEGHEM, Ph. Structure et affinités des *Stachycarpus*, genre nouveau de la famille des Conifères. Bull. Soc. Bot. Fr. 38: 162-176. 1891.

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